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ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND WATER--ETC F/6 19/6
COMPARATIVE EVALUATION TEST OF THE LIGHTWEIGHT COMPANY MORTAR A--ETC(U)
AUG 79 J J BATTAGLIA
ARLCB-MR-79032

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A test was conducted to evaluate a proposed design change for the Lightweight Company Mortar, XM8E2 baseplate. The mortar was test fired with the standard XM8E2 baseplate and a modified baseplate representing the design change. The performance of the modified baseplate appeared equal to that of the standard baseplate.		

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BACKGROUND

The XM8E2 baseplate is an auxiliary baseplate for the 60mm, XM224E3 Light Weight Company Mortar (LWCM). This baseplate is used with the mortar for the hand held, direct lay mode of firing.

A potential contractor is willing to manufacture this baseplate provided the design is altered such that the spade or rib tip radius is changed from 1/16-inch to 1/8-inch and the rib thickness is increased by 1/8-inch. Since this contractor is willing to deliver considerably earlier than other manufacturers, his proposal warrants evaluation.

MATERIALS USED

A standard XM8E2 baseplate, Serial No. 8, was modified to simulate the proposed design change, by forming 1/16-inch steel plate around each rib and fastening it in place with epoxy resin. A standard baseplate, Serial No. 10, was tested along side the modified one for a comparative evaluation of baseplate seating and mortar performance. Both baseplates are shown in Figure 1.

The 60mm M49A4 (M19 mortar) ammunition was fired in this test since the M720 (LWCM) ammunition is not in production. Ballistic information on the M720 and the M49A4 ammunition fired from the XM224E3 mortar (XM225E4 cannon) is listed in Table 1.

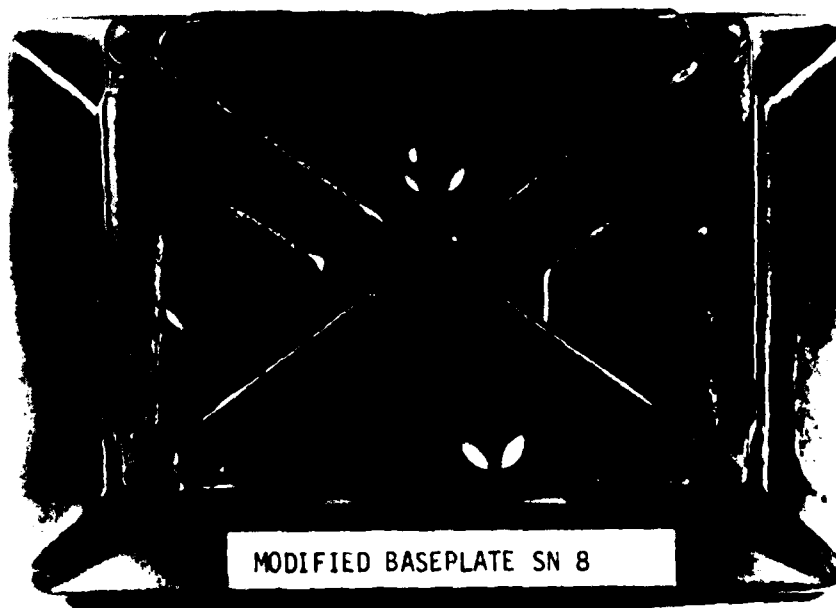
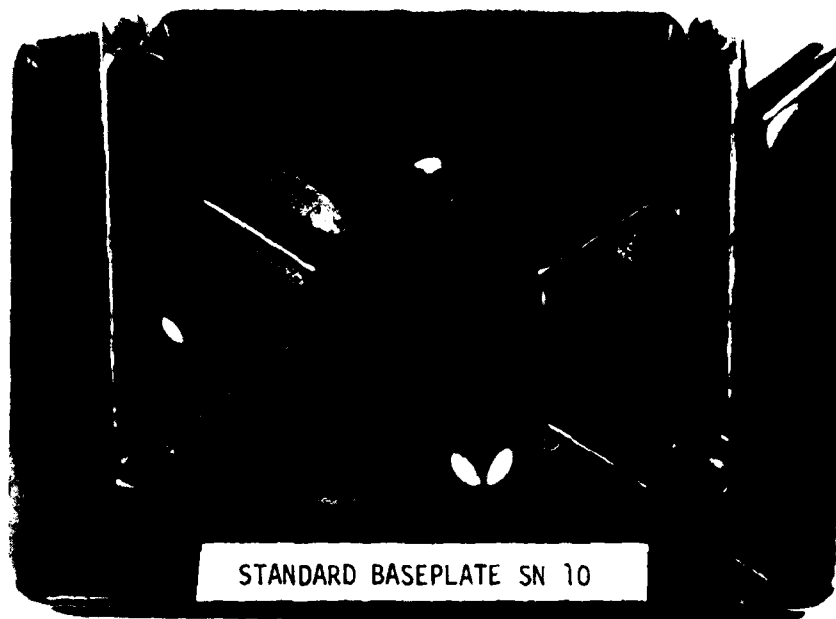


FIGURE 1. XM8E2 BASEPLATES

TABLE 1
BALLISTIC DATA

<u>AMMUNITION</u>	<u>CHARGE</u>	<u>VELOCITY (fps)</u>	<u>PROJ WT (lbs)</u>	<u>IMPULSE (lb.sec.)</u>
M720	0	213	3.75	24.8
M720	1	413	3.75	48.0
M49A4	1	292	3.10	28.1
M49A4	2	390	3.10	37.5
M49A4	3	477	3.10	45.9
M49A4	4	551	3.10	53.0

When the XM8E2 baseplate is used with the XM225E4 cannon, the M720 ammunition at charges 3 and 4 is not permitted because of the larger impulses imparted to the baseplate. For this test, the M49A4 at charge 3 was chosen because it approximates the impulse of the M720 at charge 1.

DETAILS OF TEST

All test firings were conducted at the US Marine Corps Development and Educational Command (USMDEC), Firepower Division at Quantico, VA on 11 July 1979. Two Marine gunners, Sgts Knobel and Hawthorne, fired all the test rounds from the mortar in hand directed, trigger fire mode.

Each of the baseplates (standard and modified) experienced test firings with the tube at minimum and maximum elevations. The maximum elevation for the test was established at 1431 mils for compliance with USMDEC safety requirement specifying 500 meters as the minimum

mortar firing range. The minimum elevation was established at 1156 mils which is the minimum elevation for firing with the XM8E2 baseplate in the unbraced position. The elevations of 1156 mils and 1431 mils were initially determined with a gunner's quadrant and marked on the handle range indicator for reference during the test.

The mortar was fired from four different sites. The first 29 rounds were fired from Sites #1 and #2 where horizontal baseplate displacement and baseplate surface-to-ground distances were measured. At Sites #1 and #2, the baseplates were located adjacent to one another for firing at maximum elevation and moved rearward about one foot for firing at minimum elevation. The baseplate locations for Site #1 are illustrated in Figure 2.

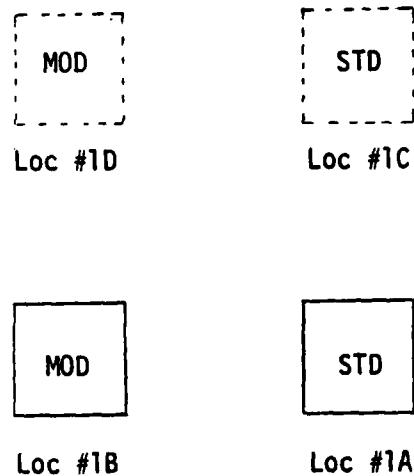


FIGURE 2. Site #1 Locations

The last 21 rounds were fired from Sites #3 and #4. Here, gunners were allowed to fire at various targets 500 to 1100 meters down range. At Sites #3 and #4 the baseplates were located adjacent to one another. At all the sites, the soil consisted of hard-packed sand. At Site #2, the soil was considerably harder packed than at the other sites because this site was in an area which was subject to pedestrian traffic.

RESULTS

The data sheets for this 50 round test are found in Appendix B. Reduction of this data for the first 29 rounds, where horizontal and vertical displacement measurements were recorded, is given in Table 2. As expected, rearward movement was greatest at the minimum elevation. The standard baseplate moved a total distance of 1.0 inches and the modified baseplate 1.2 inches. At Site #2 where the soil was firmer, rearward movement in both cases was less than at Site #1. For each round, baseplate seating was estimated as a percentage of initial surface-to-ground distance measured prior to firing the first seating round. This percentage was calculated for measurements taken at the baseplate's rear right edge and center right edge. The average was taken to determine the final percent seating found in Table 2.

For the 21 rounds fired from Sites #3 and #4, seating occurred in three and four rounds respectively, for the standard baseplate and four and six rounds for the modified baseplate. The two Marine gunners, who were not experienced in the hand directed mode of fire, managed to have a good effect on two of the targets. The gunners experienced difficulty in actuating the trigger mechanism (possibly due to dirt in

TABLE 2.
BASEPLATE SEATING DATA

LOC #	BASE-PLATE	ELEVATION (MILS)	SEATING RD #	HORIZONTAL DISPL (IN) CUM INCR		VERTICAL DISPL (IN)				% SEATED
						REAR		CENTER		
						CUM	INCR	CUM	INCR	
1A	STD	1431	1	0	0	1.7	1.7	1.2	1.2	63
			2	0	0	2.1	0.4	1.7	0.5	84
			3	0.3	0.3	3.0	0.9	1.8	0.1	100
1B	MOD	1431	1	0	0	1.1	1.1	0.1	0.1	40
			2	0	0	1.7	0.6	1.5	1.4	65
			3	0.1	0.1	3.0	1.3	2.1	0.6	100
1C	STD	1156	1	0.8	0.8	1.6	1.6	1.5	1.5	65
			2	1.0	0.2	2.1	0.5	2.0	0.5	88
			3	1.0	0	2.8	0.7	2.0+	+	100
1D	MOD	1156	1	0.7	0.7	0.6	0.6	0.7	0.7	25
			2	1.0	0.3	1.3	0.7	1.4	0.7	56
			3	1.2	0.2	1.8	0.5	2.1	0.7	82
			4	1.2	0	2.9	1.1	2.1+	+	100
2A	STD	1431	1	0.4	0.4	0.5	0.5	0.5	0.5	20
			2	0.4	0	0.6	0.1	0.6	0.1	24
			3	0.5	0.1	0.7	0.1	0.6	0	27
			4	0.5	0	0.8	0.1	0.6	0	29
2B	MOD	1431	1	0.1	0.1	0.4	0.4	0.7	0.7	26
			2	0.5	0.4	0.7	0.3	1.0	0.3	39
			3	0.7	0.2	1.0	0.3	1.2	0.2	50
			4	0.7	0	1.1	0.1	1.3	0.1	55
2C	STD	1156	1	0.3	0.3	0.4	0.4	0.4	0.4	17
			2	0.6	0.3	0.6	0.2	0.6	0.2	23
			3	0.6	0	0.6	0	0.6	0	26
			4	0.7	0.1	0.8	0.2	0.7	0.1	33
2D	MOD	1156	1	0.5	0.5	0.6	0.6	0.5	0.5	21
			2	0.8	0.3	0.7	0.1	0.6	0.1	26
			3	0.9	0.1	0.8	0.1	0.8	0.2	31
			4	0.9	0	1.0	0.2	0.9	0.1	37

the mechanism) which may have interfered with their concentration in engaging the targets. At the conclusion of the test, Gunners Knobel and Hawthorne both stated that from the gunner's viewpoint they noticed no difference in the two baseplates.

CONCLUSIONS

There is no degradation in operational effectiveness of the mortar system with the modified baseplate. Seating characteristics are very similar and gunner effectiveness is not impaired. The stability of the modified baseplate appeared equal to that of the standard baseplate. Although the test data were obtained on only one type of soil, Virginia sand, the risks in accepting the modified design are minimal.

APPENDIX A

TEST PLAN

I. AMMUNITION: 50 rounds 60mm M49A4, Charge 3.

II. FIRING MATRIX FOR SEATING MEASUREMENTS:

ELEVATION	<u>STANDARD BASEPLATE</u>		<u>MODIFIED BASEPLATE</u>	
	Site		Site	
	#1	#2	#1	#2
MAXIMUM (1431 mils)	Gunner #1 4 rds max	Gunner #1 4 rds max	Gunner #2 4 rds max	Gunner #2 4 rds max
MINIMUM (1156 mils)	Gunner #2 4 rds max	Gunner #2 4 rds max	Gunner #1 4 rds max	Gunner #1 4 rds max

III. The balance of the 50 rounds will be fired from Sites #3 and #4 at targets between 500 and 1100 meters.

APPENDIX B

TEST DATA

DATE OF TEST: 11 July 1979

WEAPON: XM224E3 Mortar, SN 21
XM225E4 Cannon, SN 16

AMMUNITION: M49A4, B632
Lot MA-21
Loaded 12-74
Charge 3

GUNNERS: #1 - Sgt Knobel, USMC
#2 - Sgt Hawthorne, USMC

TEST RD #	SEATING RD #	BASEPLATE (STD OR MOD)	ELEVATION (MILS)	CUM HOR DISPLACEMENT (INCHES)	SURF TO GRD DISTANCE AT REAR (INCHES)	CUM VERT DISPLACEMENT AT REAR (IN)	SURF TO GRD DISTANCE AT CENTER (IN)	CUM VERT DISPLACEMENT AT CENTER (IN)	REMARKS
		STD			3.025		1.775		Site #1: Soil - hard-packed sand, baseplate at Loc #1A. Gunner #1.
1	1	STD	1431	0	1.325	1.700	0.525	1.250	
2	2	STD	1431	0	0.900	2.125	0.050	1.725	
3	3	STD	1431	0.30	0	3.025	0	1.775	Baseplate fully seated.
		MOD			3.050		2.075		Baseplate at Site #1, Loc #1B.
4	1	MOD	1431	.020	2.000	1.050	1.125	0.950	Gunner #2.
5	2	MOD	1431	.020	1.325	1.725	0.550	1.525	
6	3	MOD	1431	.070	0.025	3.025	0	2.075	Baseplate fully seated.
		STD			2.750		2.050		Baseplate at Site #1, Loc #1C.
7	1	STD	1156	0.825	1.125	1.625	0.575	1.475	Gunner #1.
8	2	STD	1156	0.950	0.650	2.100	0	2.050	
9	3	STD	1156	0.950	0	2.750	0	2.050	Baseplate fully seated.
		MOD			2.850		2.100		Baseplate at Site #1, Loc #1D.
10	1	MOD	1156	0.675	2.300	0.550	1.425	0.675	Gunner #2.
11	2	MOD	1156	1.025	1.525	1.325	0.725	1.375	
12	3	MOD	1156	1.175	1.025	1.825	0	2.100	Baseplate almost seated.
13	4	MOD	1156	1.200	0	2.850	0	2.100	Baseplate fully seated.

TEST RD #	SEATING RD #	BASEPLATE (STD OR MOD)	ELEVATION (MILS)	CUM HOR DISPLACEMENT (INCHES)	SURF TO GRD DISTANCE AT REAR (INCHES)	CUM VERT DISPLACEMENT AT REAR (IN)	SURF TO GRD DISTANCE AT CENTER (IN)	CUM VERT DISPLACEMENT AT CENTER (IN)	REMARKS
14	1	STD	1431	0.450	3.225	0.475	2.025	0.525	Site #2: Soil - very hard-packed sand silt mix, baseplate at Loc #2A. Gunner #2 - Air bubble problem in handle range Indicator.
15	2	STD	1431	0.450	2.675	0.550	1.400	0.625	
16	3	STD	1431	0.475	2.525	0.700	1.375	0.650	
17	4	STD	1431	0.475	2.400	0.825	1.375	0.650	
18	1	MOD	1431		2.550		1.975		Baseplate at Site #2, Loc #2B. Gunner #1.
19	2	MOD	1431	0.125	2.100	0.450	1.300	0.675	
20	3	MOD	1431	0.525	1.825	0.725	1.000	0.975	
21	4	MOD	1431	0.725	1.550	1.000	0.775	1.200	
				0.725	1.450	1.100	0.650	1.325	Baseplate at Site #2, Loc #2C. Gunner #2.
22	1	STD	1156	0.325	2.925	0.450	1.975	0.375	
23	2	STD	1156	0.550	2.475	0.550	1.600	0.550	
24	3	STD	1156	0.575	2.375	0.625	1.425	0.600	
25	4	STD	1156	0.675	2.300	0.850	1.375	0.725	
					2.075		1.250		

TEST RD #	SEATING RD #	BASEPLATE (STD OR MOD)	ELEVATION (MILS)	CUM HOR DISPLACEMENT (INCHES)	SURF TO GRD DISTANCE AT REAR (INCHES)	CUM VERT DISPLACEMENT AT REAR (IN)	SURF TO GRD DISTANCE AT CENTER (IN)	CUM VERT DISPLACEMENT AT CENTER (IN)	REMARKS
		MOD			3.100		2.075		Baseplate at Site #2, Loc #2D.
26	1	MOD	1156	0.500	2.550	0.550	1.575	0.500	Gunner #1.
27	2	MOD	1156	0.750	2.450	0.650	1.450	0.625	
28	3	MOD	1156	0.875	2.350	0.750	1.300	0.775	
29	4	MOD	1156	0.925	2.150	0.950	1.175	0.900	
30	1	STD		-	-	-	-	-	Target shooting. Site #3: Soil - hard-packed sand, baseplate at Loc #3A, target at 750M.
31	2	STD		-	-	-	-	-	Baseplate fully seated.
32	3	STD		-	-	-	-	-	
33	4	STD		-	-	-	-	-	
34	5	STD		-	-	-	-	-	
35	1	MOD		-	-	-	-	-	Baseplate at Site #3, Loc #38. Gunner #2. target at 1000M.
36	2	MOD		-	-	-	-	-	Almost seated. Baseplate fully seated.
37	3	MOD		-	-	-	-	-	
38	4	MOD		-	-	-	-	-	
39	5	MOD		-	-	-	-	-	

TEST RD #	SEATING RD #	BASEPLATE (STD OR MOD)	ELEVATION (MILS)	CUM HOR DISPLACEMENT (INCHES)	SURF TO GRD DISTANCE AT REAR (INCHES)	CUM VERT DISPLACEMENT AT REAR (IN)	SURF TO GRD DISTANCE AT CENTER (IN)	CUM VERT DISPLACEMENT AT CENTER (IN)	REMARKS
40	1	MOD		.	.	.	.	.	Site #4: Soil - hard-packed sand, baseplate at Loc #4A, Gunner #2, target at 1100M. Gunner had difficulty firing because of problems with trigger mechanism.
41	2	MOD		.	.	.	.	.	Gunner #1.
42	3	MOD		.	.	.	.	.	Gunner #2.
43	4	MOD		.	.	.	.	.	Gunner #1, almost seated.
44	5	MOD		.	.	.	.	.	Good effect on target.
45	6	MOD		.	.	.	.	.	Baseplate 100% seated.
46	1	STD		.	.	.	.	.	Baseplate at Site #4, Loc #4B, target at 750M, Gunner #2.
47	2	STD		.	.	.	.	.	Direct hit! Baseplate 50% seated.
48	3	STD		.	.	.	.	.	New target at 1000M, baseplate almost seated.
49	4	STD		.	.	.	.	.	Baseplate fully seated.
50	5	STD		NOTE: After Rd #40, problems with the trigger mechanism continued. The trigger had to be squeezed, released, and squeezed again in order to fire. After Rd #50 and a few dry pulls, it would not work at all.

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by

J. J. Battaglia

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